

We Claim:

1. A method for forming propylene comprising providing a feedstock containing at least in part a first mixture of hydrocarbons comprising alpha olefins, internal linear olefins, and isoolefins having four carbon atoms per molecule, introducing said feedstock into a combination hydrogenation/double bond isomerization zone wherein (1) any diolefins and acetylenes that may be in said feedstock are converted at least in part to alpha and internal linear olefins, and (2) at least part of said alpha olefins in said feedstock and at least part of said alpha olefins formed by said hydrogenation are converted to additional internal linear olefins thereby producing as a product of said combination zone a second mixture that is enriched in internal linear olefins, passing said second mixture into a distillation zone wherein said second mixture is split into an overhead fraction that is enriched in alpha olefins and isoolefins, and a bottoms fraction that is enriched in internal linear olefins, passing said overhead fraction into a skeletal isomerization zone wherein said isoolefins are converted at least in part to additional internal linear olefins to form a third mixture that is enriched in internal linear olefins, returning said third mixture as co-feed to at least one of said combination zone and said distillation zone for at least one of the formation of additional internal linear olefins in said combination zone and the separation of internal linear olefins in said third mixture into said bottoms fraction, passing said bottoms fraction and ethylene into a metathesis zone which favors the disproportionation of internal olefins with ethylene to produce propylene as a product of the process.
2. The method of claim 1 wherein unreacted internal linear olefins are recovered from said metathesis zone and returned to the process as an additional source of internal olefin feed for said metathesis zone.

3. The method of claim 2 wherein said internal linear olefins recovered from said metathesis zone are returned as co-feed to said distillation zone.
4. The method of claim 1 wherein said first mixture contains at least in part butene-1, butene-2, and isobutylene, said combination zone contains at least one catalyst that promotes the selective hydrogenation of butadiene and vinyl acetylenes, and the formation of butene-2 from butene-1, butene-2 is recovered in said bottoms fraction, said metathesis zone contains at least one catalyst that promotes the disproportionation of butene-2 with ethylene to form propylene, said overhead fraction contains butene-1 and isobutylene, said skeletal isomerization zone contains at least one skeletal isomerization catalyst that promotes the conversion of isobutylene to a mixture of butene-1 and butene-2, said mixture of butene-1 and butene-2 along with any unconverted isobutylene being recovered from said skeletal isomerization zone as said third mixture, and said third mixture is returned as co-feed to at least one of said combination zone and said distillation zone.
5. The method of claim 4 wherein said combination zone operating conditions are a temperature of from about 70°F to about 270°F, a pressure of from about 20 psig to about 400 psig, and a weight hourly space velocity of from about 0.5 h⁻¹ to about 20 h⁻¹.
6. The method of claim 4 wherein said distillation zone operating conditions are a temperature of from about 20°F to about 260°F and a pressure of from about 0 psig to about 400 psig.
7. The method of claim 4 wherein said metathesis zone operating conditions are a temperature of from about 300°F to about 800°F, a pressure of from about 200 psig to about 600 psig, and a weight hourly space velocity of from about 1 h⁻¹ to about 100 h⁻¹.
8. The method of claim 4 wherein said skeletal isomerization operating conditions are a temperature of from about 450°F to about 1,200°F, a

pressure of from about 0 psig to about 150 psig, and a weight hourly space velocity from about 1 h^{-1} to about 50 h^{-1} .

9. The method of claim 4 wherein said combination zone catalyst is at least one of palladium, platinum, nickel, and rhodium carried on an acidic support.
10. The method of claim 4 wherein said metathesis zone catalyst is at least one of halides, oxides, and carbonyls of at least one of molybdenum, tungsten, rhenium, and magnesium carried on a support.
11. The method of claim 4 wherein said skeletal isomerization zone catalyst is at least one zeolite having one dimensional pore structures with a pore size ranging from greater than about 0.42nm and less than about 0.7nm.
12. The method of claim 1 wherein said feedstock contains, in addition to said first mixture, butadiene, vinyl acetylene, n-butane, isobutene, and hydrogen; in said distillation zone said n-butane separates with said butene-2 and both n-butane and butene-2 are passed to said metathesis zone; in said distillation zone said isobutylene, butene-1, and isobutane separate from said n-butane and butene-2 and are passed to said skeletal isomerization zone, said third mixture product of said skeletal isomerization zone that is returned as co-feed to at least one of said combination zone and said distillation zone contains butene-1, butene-2, isobutylene, and isobutane, said butadiene and vinyl acetylene in said first mixture are hydrogenated at least in part in said double bond isomerization zone to at least a mixture of butene-1 and butene-2, and said butene-1 in said first mixture is converted at least in part in said double bond isomerization zone to butene-2.
13. The method of claim 12 wherein a stream containing said butene-2 and n-butane is recovered from said metathesis zone and returned to the process for recycling said butene-2 to said metathesis zone.
14. The method of claim 13 wherein said stream is recycled as co-feed to said distillation zone.

15. The method of claim 12 wherein a purge stream containing at least one of n-butane, butene-1, butene-2 and isobutane is removed from at least one of said skeletal isomerization zone and said metathesis zone and employed in an alkylation zone to form an alkylate of mixed isooctanes.
16. The method of claim 12 wherein in addition to a propylene product, a separate gasoline grade olefin product is recovered from said metathesis zone.